

SecuRoute

Improving Transportation Security through Risk Analytics and Elicitation

ORNL SecuRoute Team

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Understanding Route Risk: A Hard Problem

- Hundreds of hazardous shipments traverse US highways each year, often covering long distances
- The hazardous material transport community currently lacks a data-driven understanding of risk conditions along routes within the US
- Real-world conditions are dynamic
- Limited consensus on risk severity for various conditions



Why Is This Hard?

- Real-world conditions are constantly changing – “low risk” today may not be “low risk” tomorrow
- High risk conditions are defined differently by different stakeholders
- Quantifying risk is challenging and highly subjective
- Near impossible to calculate probabilities of rare events given lack of data collection
- Taking a geospatial “big data” approach requires significant computing and data management/manipulation expertise

Black/Gray Swans

- Black Swans – events that are unlikely or rare with extremely high consequences
- Gray Swans – events that are known and possible but are highly unlikely to occur
- Limited prior examples exist to compute probability, and consequences can be incalculable
- Hampers classic risk assessment of the form $risk = probability * consequence$



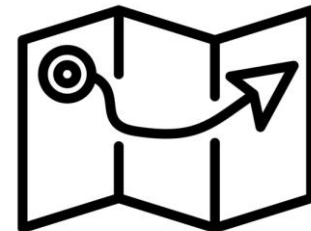
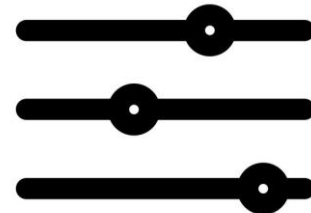
www.theatlantic.com/photo/2011/09/911-the-day-of-the-attacks/100143/
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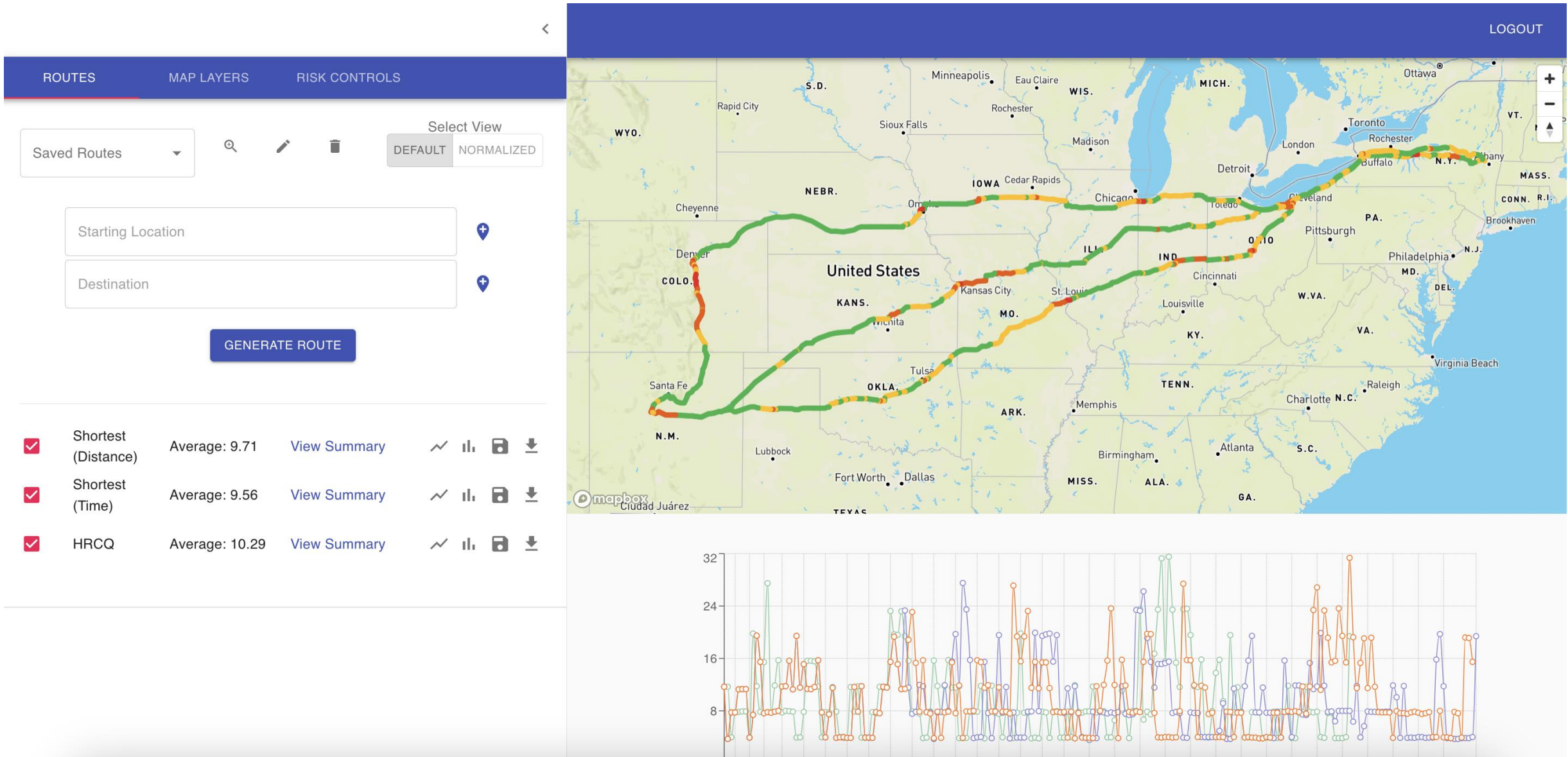
https://www.youtube.com/watch?v=gCuZuclmY_Y

ORNL is tackling these challenges with SecuRoute

- SecuRoute is an interactive, web-based analysis and mapping application that allows users to:
 - Derive secure transport routes within the United States
 - Analyze and score routes for vulnerability to risk
 - Customize risk conditions by importance/priority
 - Understand the risk vulnerability for every segment along a route



SecuRoute Overview



FY23 Application Enhancements

- High-fidelity highway network
 - From 30,000 links in the network to 30,000,000 links in the network (1000x increase in fidelity)
- Canada highway network
 - Routing into the US from north of the border
- Custom geocoding capability
 - Enables address searching across the US
- Multi-route options
 - Shortest, fastest, and HRCQ options, all with risk profiles
- Improved user experience
 - Save routes for recalling later, download routes, compare routes
- Infrastructure Upgrades and DevOps deployment pipeline
 - High-reliability operational environment and streamlined SW updates

The Perception of Risk

Bridges are a high-risk area along a route

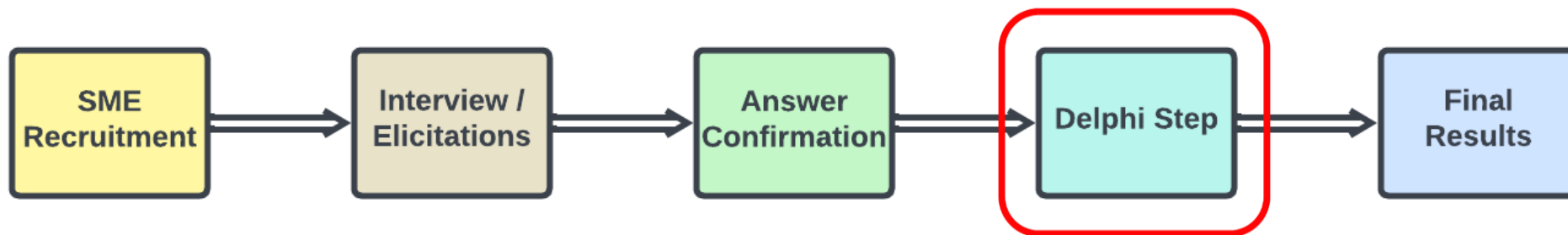
Bridges can be risky under a given set of conditions

Bridges aren't risky at all, I know my truck's dimensions



Addressing Risk Perception with Elicitation

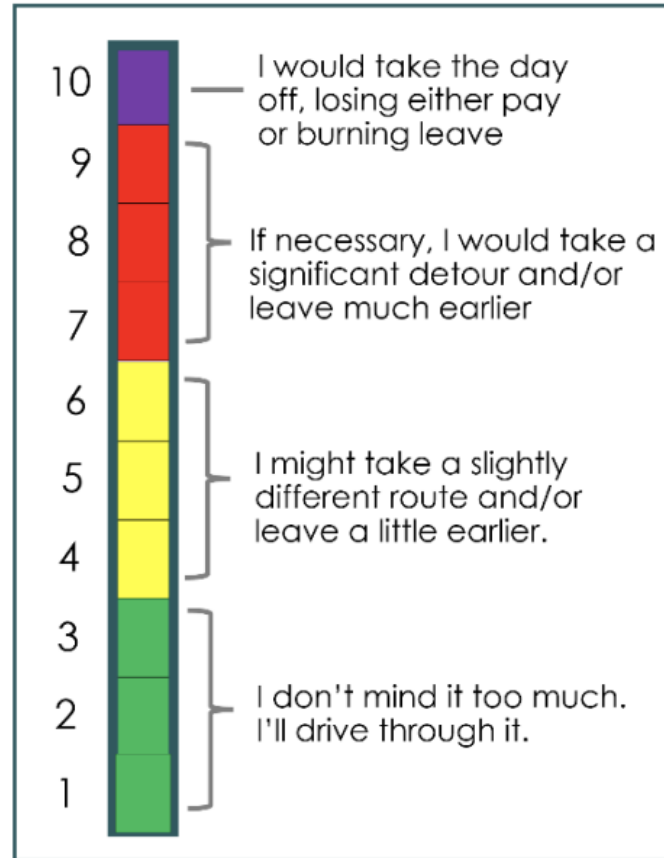
- To address inconsistencies in risk perception, we are eliciting experts across the transportation security stakeholder community
- Elicitation is a structured interview with subject matter experts
- Focused on understanding *perceived risks* for a set of roadway conditions, during the planning phase
- Resulting aggregated risk perception metrics are applied to roadway links in SecuRoute



Elicitations

Bridges
Tunnels
Railroad Crossings
Congestion
Vehicle Communications
Elevation
Road Conditions
Population
Public Unrest
Weather
Security Services
Medical Services
Mechanical Services
Safehavens

Likert-RP Scale (Worked out example)



Weather Scenario	Low	High	Mid
Heavy rain	2	6	3
Snow (4"-8") with no ice	8	10	9
Significant ice, some snow	10	10	10

Notice The mid doesn't have to be centered between the low and high

Notice the range and mid can be the same number if that feels right.

Notes/Discussions

Heavy rain depends on how heavy. Also, heavy rain might be a visibility issue, but it might also be a flooding problem. So, I ranged over all these by choosing 2-6. But no way am I going in the ice. Full stop.

- First ever elicitation of its kind
- Interviews with ~20 professionals across many stakeholder groups
- Elicited for 14 features and 42 different conditions

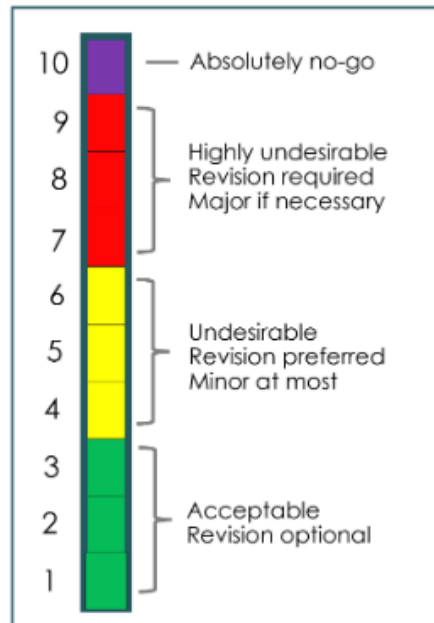
Example Elicitation: Congestion

Congestion

Here we choose three traffic congestion scenarios: heavy stops and long waits, extended stop and go, and brief stop and go. The first refers to a particularly terrible traffic jam where you are not moving for significant periods of time (called, "parking lot traffic"), and this is occurring over a long stretch of road. The second is an extended period of stopping and going, frequent tapping of the breaks, but only short stops but lasting for quite some time. The third is congestion that is only brief in distance and time and mostly stop and go. Take each scenario one at a time, assuming only one such incident of each occurs on the route and first provide low and high values. Then return and think about a single value. Remember there are no wrong answers, but we ask that you do consider the scenarios carefully and provide answers you feel comfortable with after some reflection. Recall also that we will aggregate all contributor answers anonymously and report back what the group range and mid values were, giving you additional time to think about the issue and perhaps adjusting the answers you have provided. You also will have a chance to talk at length about your concerns or suggestions for clarifying concern about traffic congestion. It may feel difficult but just do your best!

← Congestion Scenarios Descriptions

Likert-RP Scale



Congestion Scenario	Low	High	Mid
Heavy stops & long waits "a parking lot" over multiple miles			
Extended stop & go > 1 mile			
Brief stop & go < 1 mile			

← Contributor provided risk metrics

Notes/Discussions

← Comments on the metric values, scenarios, etc.

Status

- 13 Contributors interviewed so far (first batch)
- 4 more scheduled and total of 20 anticipated
- Analysis of results underway
- Results by end of calendar year
- More contributors needed! You can help!





SecuRoute

SecuRoute is a tool developed by ORNL to help security planners develop secure and safe routes for moving high-consequence shipments within the United States.

SecuRoute is a web-based platform that contextualizes nationwide risk context for any planned in-country route. The platform analyzes static and real-time route conditions and provides users with risk summaries, including detailed risk factors, for each route segment.

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